Light and Lighting

Vol. XLII.—No. 6 June, 1949 Price - One Shilling

JOURNAL OF SEEING AND ILLUMINATION

Light and Lighting

32, Victoria St., London, S.W.1.

Telephone ABBey 5215

Incorporating "The Illuminating Engineer."

Official Journal of The Illuminating Engineering Society.

Vol. XLII.—No. 6 | June, 1949 | PRICE ONE SHILLING Subscription 15/- per annum, post free

CONTENTS

Town and Country Vision

BROADLY speaking, countrymen are outdoor folk while townsmen are indoor folk. The former do little close seeing and have the benefit of natural lighting, with high levels of illumination; the latter do much close seeing with lower levels of daylight illumination, and often with still lower levels under artificial lighting. It is legitimate to ask how far these differences in the usage of the eyes, and in the conditions for seeing may be responsible for the variation of visual standards with degrees of urbanization disclosed by Dr. W. J. Martin's report on the physique of young adult males, just issued by the Medical Research Council. Dr. Martin's analysis of data relating to over 90,000 men in Gt. Britain between the ages of 20 and 21 shows that rural districts had no less than 10.6 per cent. more men with perfect vision than the county boroughs. In all regions of the country, it appears that visual standards are better in urban districts than in towns, and they are better still in rural districts. These findings certainly give us food for thought.

Illumination Notes and News

A. P. Trotter's Reminiscences

During his retirement at the little Wiltshire village of Teffont the late Mr. A. P. Trotter devoted part of his time to writing his reminiscences, the manuscript of which he deposited with the Institution of Electrical Engineers only a short time before his death in 1947. These memoirs have now been abridged and edited by Mr. F. W. Hewitt, a former Assistant Secretary of the Institution, and six typescript copies have been made and bound copies have been presented to Mrs. A. P. Trotter, the Science Library, and to the Illuminating Engineering Society.

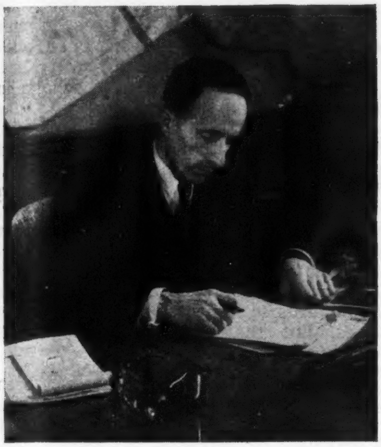
These memoirs are most readable, and, in view of Mr. Trotter's long connection with the electrical industry from its earliest days, are full of interest. But electricity and lighting were not Trotter's only interests; readers may be somewhat surprised to learn that for nearly 12 years he was the holder of the mile record on a "penny-farthing" bicycle. He gave up bicycling at the age of 80. He was also a humorist. During his time at the Board of Trade he had to attend many committee meetings, particularly on definitions, which at that time were somewhat troublesome. One of his jobs was to record the definitions which were settled, but includes the following, which he could not resist adding—*Committee*: An apparatus for concentrating work on the shoulders of one or two men who work between the meetings, and distributing the credit among those who talk most at the meetings.

Monsieur Gaymard

On page 140 of this issue we give some further details of the proceedings at the annual meeting of the I.E.S., including a short summary of the address on public lighting in France which was given by Monsieur L. Gaymard. Though M. Gaymard is already well known to many street lighting engineers in this country, we thought we might all like to know a little more about him. We discovered that, after being educated at the Ecole Polytechnique in Paris, M. Gaymard graduated as a Doctor of Law. Up to the outbreak of war in 1939 he was assistant general secretary of the Compagnie Parisienne de Distribution d'Electricité.

On September 1, 1939, he was mobilised with the French Army and saw service as a Staff Captain in the 1940 campaign. After the armistice he was demobilised, and in September, 1940, he was appointed assistant to the Chief Engineer of the Public Lighting Department of the C.P.D.E.

The use of street lighting being of course restricted during this period, M. Gaymard availed himself of the opportunity to make a study of the design of street lighting apparatus, with a view to producing simplified apparatus which would give



Monsieur Gaymard.

better light distribution and at the same time facilitate maintenance.

In 1942 he was appointed as Chief Engineer of the Public Lighting Department of Electricité de France. At this time, of course, Paris was occupied by the Germans, and M. Gaymard took advantage of the fact that his maintenance men had to go about the streets daily to prepare detailed plans of the German defences of Paris. During the occupation he kept his men fully employed, so that the lighting could be switched on when required, but also so that his department could make a good case to prevent their employees being called up for service with the Germans. As a result of this Paris was fully lighted within 48 hours of the liberation.

M. Gaymard is giving much attention at the present time to the modernisation of the street lighting and traffic signals of Paris, and during his recent visit to this country took the opportunity of meeting experts and seeing the latest developments in this country on these subjects. M. Gaymard is President of the Association Française de Eclairagistes and a member of the Société des Ingenieurs Civil de France.

The full text of M. Gaymard's address, which was excellently delivered and was well received by I.E.S. members at the meeting, will, of course, be published in the "Transactions" in due course.

The N.P.L.

On May 26 and 27 the N.P.L. at Teddington was open to the inspection of scientists and technologists from all over the country, including representatives of industrial organisations, members of university staffs and Government departments. This annual event and the demonstrations of scientific work which are arranged for the benefit of visitors enable the latter to see something of the broad scope of the work covered by the laboratory.

It also provides an opportunity for the visitor to get away from his own particular "line" and to play the "innocent" in other intriguing scientific fields. Of course no lighting man would omit to visit the Light Division but he might well be excused if on the way he got involved with wind tunnels, the tanks of the Ship Division or the attractions of the Tidal Model Laboratory.

Sooner or later, however, the visitor interested in lighting matters would find himself on more familiar ground even though he may find it somewhat difficult to understand all the demonstrations dealing with optics and photometry. A number of new demonstrations were on view including a method of measuring the spectral energy distribution of fluorescent lamps in the visible and ultraviolet regions of the spectrum. The work being undertaken by the Light Division of the Laboratory is, however, so wide that it cannot adequately be described here and it is hoped to deal with it more fully in a subsequent issue of the journal.

I.E.S. Annual Meeting

In presenting the Report of the Council for 1948 at the Annual General Meeting of the I.E.S. at the Royal Society of Arts on May 10, the President, Mr. J. M. Waldram, made reference to one or two outstanding events of the year. The first of these was the Summer Meeting, the first event of its kind arranged by the Society, which was held at Harrogate. This, he said, had been acknowledged as a most successful function, so successful in fact that even the town in which it was held, by no means unaccustomed to such events, had been somewhat surprised. He said that he looked forward to a continuance of these meetings, though he thought it might be difficult to maintain the high standard set last year.

Another important step taken during the past year was the introduction of the Register of Lighting Engineers. It was impossible, he said, for the Society, under its existing articles of association, to become a fully professional body, nor did it seem desirable that it should become one; the introduction of the Register within the present articles, however, had been a step in the right direction in recognising those members of the Society who were professionally engaged on lighting.

The President also referred to the informal meetings and visits which now formed an important part of the London programme. He also referred to the Symposium on Searchlights, published during 1948, which had been well received by the technical Press throughout the world.

As reported in the last issue of the journal (p. 113) the proposals to amend the by-law governing admission to Fellowship of the Society was carried, and the ballot on nominations for members of Council for the forthcoming session resulted in the Council's nominees being elected. The officers of the Society for the next session were also announced in our last issue.

After the formal business had been concluded an address on public lighting in France and England at the present time was given by Monsieur Ludovic Gaymard, Street Lighting Engineer of Paris.

M. Gaymard compared street lighting practice in the two countries, the main difference being that whereas in this country we are chiefly concerned with the efficiency of the lamps, equipment, and lighting installation as a whole, in France, and particularly in Paris, far more attention is given to aesthetics. For instance, though mercury and sodium light sources have their applications in the lighting of main roads in open country, they are not used in towns, where people would apparently take far greater objection to the colour distortion than they do in England. Mercury lamps are used on some of the Paris boulevards to light up the foliage of the trees, but that is not strictly street lighting.

Glare is a problem which has been given considerable attention in this country, but we still project light from street-lighting lanterns at angles very close to the horizontal. The French on the other hand use lanterns which give a maximum intensity at angles from 70 deg to 78 deg. to the vertical, the maximum never being above 80 deg, as is often the case in other countries.

Tests are now being made in Paris on fluorescent street lighting equipment, but results are not yet available. It also appears that experiments are being carried out on the application of high voltage fluorescent tubes to public lighting. The results of these tests will be awaited with interest.

M. Gaymard showed a number of lantern slides to illustrate how aesthetic considerations have influenced the design of street lanterns and columns. Every effort is made in Paris to reduce the number of obstructions on pavements, and where possible lanterns are fixed to attractively designed wall brackets. It is interesting to note that notwithstanding their low cost of maintenance concrete lamp columns are not at all popular, aluminium paint (so popular in this country) is avoided and columns are usually painted to give them the appearance of weathered bronze.

A vote of thanks to M. Gaymard was proposed by Dr. J. W. T. Walsh and seconded by Mr. R. O. Ackerley. Both speakers complimented M. Gaymard on the manner in which he had presented his address. In reply, M. Gaymard said he felt very honoured at being able to address the I.E.S., and thanked the Society for their very warm welcome.

The President's table. Left to right, Mr. C. R. Bicknell, Mrs. Waldram, Sir Henry Self, The President, Mrs. Bicknell and Mons. L. Gaymard.

THE I.E.S. ANNUAL DINNER

A summary of the after dinner speeches

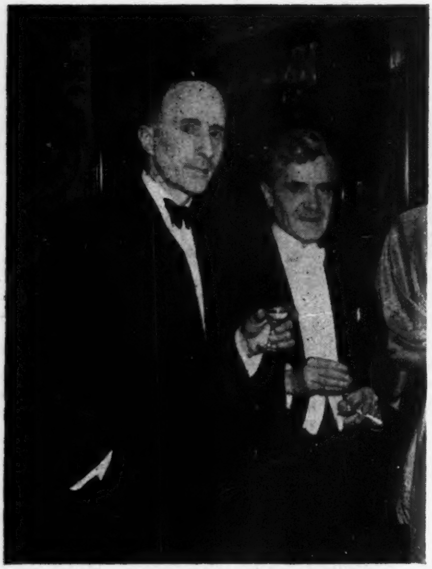
Some 200 members and their guests attended the annual dinner of the Illuminating Engineering Society, which was held at the Café Royal, Regent-street, London, on Wednesday, May 11, 1949. The president (Mr. J. M. Waldram) was in the chair.

Sir Henry Self (deputy chairman, British Electricity Authority), proposing the toast of "The Illuminating Engineering Society," said that he was privileged to address a Society which was unique in its character. The Society had voluntarily undertaken the task of bringing to the notice of the public the benefits of good lighting, and the Board which he had the privilege to serve and its Area Boards wished the Society all success in its work. At the same time, he assured the Society that the various Boards would give them all the backing they had had in the past, and would, in fact, be only too ready to give all the help that might be necessary.

The Society had now been in existence for some 40 years, and due to the work that had been done by the late Mr. Gaster and Mr. Dow, they had achieved the distinction of being the recognised authority on illumination, whilst the I.E.S. code for interiors was now generally accepted. The Society had also established its presige in regard to education by way of the City and Guilds examinations in illumination, whilst this same work had also been carried into the schools. Great progress had also been made in research, and the Society deserved great credit for the stimulation it had given in that respect.

He had been very much impressed by the fact that the Society had among its members leading ophthalmologists who were so closely concerned with the development of illumination technique in connection with vision. In his view, there should be the greatest liaison between illumination experts and those concerned with the preservation of eyesight, and he thought that the day might come when a person could go to an oculist and obtain a prescription not for glasses, but a prescription which he could take to the manufacturer and get the type of lamp most suited to his eyesight!

Be that as it may, it went without saying that the Society could do a great work in bringing home to the public that illumination was a real science and in urging the manufacturers to provide what was necessary. It was also of the greatest importance that there should be a meeting place where those responsible for the eves of the nation could discuss these things seriously with those concerned with illumination, so that we could look forward to a brighter and



Mons. Gaymard and Mr. T. G. N. Haldane.

(Electrical Review photograph.)

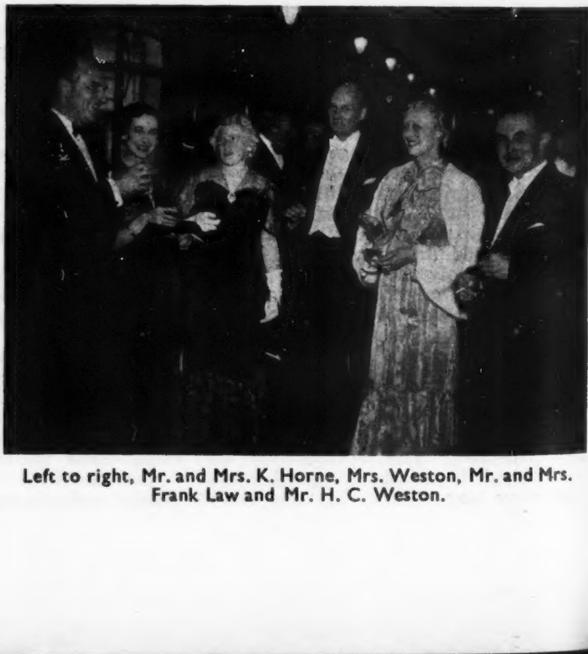
better future. In this respect, the Society was already doing a great work, and it had an important future. The British Electricity Authority believed in it and would back it to the full, and he felt that he himself would be sadly negligent if he did not become a member of the Society.

Coupling with the toast the name of the chairman, he said that Mr. Waldram was a well-known figure in the illumination world. He was in charge of one of the research sections of the General Electric Co., which he joined under the late Sir Clifford Paterson in 1925. He also expressed the pleasure of all present that Lady Paterson was present that evening.

The President, responding to the toast, said they were very glad that Sir Henry Self had been able to come to the dinner and propose this toast, for he was concerned with the supply of one of our principal necessities in the technical field to-day. We were now beginning to enjoy the fruits of technical development on which everybody would wish to congratulate the electrical industry. (As an example of this development, he said it appeared that we could now raise steam with some incombustible material to produce a second grade of electricity which could be used only in electric signs!)

Sir Henry Self had referred to two names to which he felt some mention should be made by himself. This was the first time Mr. Dow had not been present at the annual dinner, and his loss was felt by all. Then reference had been made to his late chief, Sir Clifford Paterson, whose loss he personally specially deplored, and he associated himself with the feeling of satisfaction by Sir Henry Self at the presence of Lady Paterson, which he regarded as a great honour and one which gave him extraordinary pleasure.

Whilst the death of Mr. Dow marked the end of an epoch, it also marked the beginning of an epoch. Looking around,

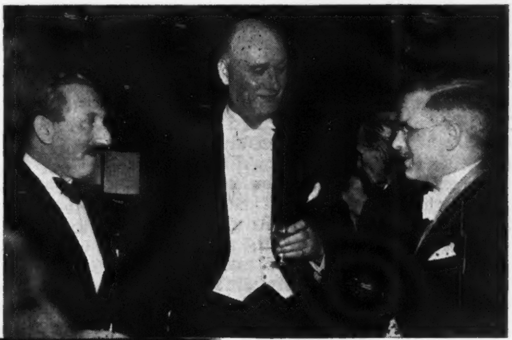


Left to right, Mr. and Mrs. K. Horne, Mrs. Weston, Mr. and Mrs. Frank Law and Mr. H. C. Weston.

there were men who had been with the Society for many years: the wise men, the senior men, who had always been available, who always could be referred to. Some of them now were beginning to shed their load, some had retired, and some, alas! were no longer with us. Now we had got to the point where men not of 55 but of 45 had to take responsibility. It was to those we had to look in the future, not only in the Society, but in regard to many things in this country at the present time. That was a matter which should be borne in mind, because those who were younger had had to take up responsibility earlier than might have been expected.

There were one or two people to whom he would like to make reference, continued the President. First, there was the secretary. One of the things which they owed to Mr. Dow was the extraordinary manner in which he managed the affairs of the Society before Mr. Cole took over, and he now wished to thank Mr. Cole for the very many things he had done for him personally and for the Society since he was appointed secretary. He also expressed this thanks to the members of the staff. He also paid tribute to the work of Mr. Weston, the honorary secretary, and to the honorary secretaries of the various Centres and Groups, whose enthusiasm had so greatly assisted in the success of the Society. A debt of gratitude, he said, was also due to the wives of these men, without whose help and sympathy it would be impossible for them to carry on the work. He was glad, therefore, to have this opportunity of thanking them.

The work of the I.E.S., he said, covered a very wide field, its members were associated with a great variety of professions, and its connections were many. He was glad that representatives of



Above, Col. H. C. Smith, Sir Henry Self and Mr. J. M. Waldram. *(Electrical Review photograph)*
Left, Dr. J. W. T. Walsh, Mrs. and Mr. R. O. Ackerley.

many bodies closely allied with the Society were present this evening. Among the many distinguished guests present were two whom he would like to mention, viz., Mr. Haldane, president of the Institution of Electrical Engineers, and Mr. Aslin, vice-president of the Royal Institute of British Architects. These were, so to speak, symbols of the activities of the Society, and he looked forward to the time when the illuminating engineer would be able to confer with both the artists and the architect and then go to the electrical engineers and ask for the lamps and accessories and control gear so that there would be a harmonious coupling-up of all three. What was wanted was the eye of the artist and the skill of the technician in one person.

Mr. C. R. Bicknell, proposing the toast

of "The Guests," said he wondered if it was appreciated that the Illuminating Engineering Society was possibly the most altruistic of all the cultural societies, in that it was composed of people who spent most of what would otherwise be leisure time in trying to brighten the lives of others. In furtherance of their aims, they welcomed and, indeed, sought the active co-operation of all those bodies and individuals who were interested in improving working and living conditions.

They were privileged to have with them Sir Henry Self, deputy chairman of the British Electricity Authority, whose record clearly showed him to be a protagonist of co-operation. Sir Henry led the mission to the United States and Canada in 1940 that resulted in the effective co-ordination of Allied production resources. Later he served with the Combined Chiefs of Staff and as British Representative in America on combined machinery—all, surely, outstanding examples of co-operation. Might he suggest to him another combined operation—electricity supply and lighting—and all they asked from him in this regard was plenty of cheap electrical energy. Given this, they could pursue their self-allotted task of making the country a brighter place to live in and more attractive to those from whom we wanted to extract dollars.

It was particularly pleasing that Col. H. C. Smith was able to be present. After a distinguished association with the gas industry extending over some 40 years, Colonel Smith on vesting day, just 10 days ago, assumed his present appointment as deputy-chairman of the new Gas Council. He must, therefore, be an extremely busy man, and they wished to let him know how much they appreciated his finding the time to be present, and that they wished him every success in his new task.

He welcomed also Mr. T. G. N. Haldane, president of the Institution of Electrical Engineers; Mr. C. H. Aslin, vice-president of the Royal Institute of British Architects; Mr. Frank Law, president of the Faculty of Ophthalmologists; Mr. Norman Boydell, president of the Association of Public Lighting Engineers; Mr. H. B. Marton, president of the British Optical Association; Mr. J. G. Briggs, president of the Electrical Contractors Association and their friends of the Press. He expressed to all these appreciation of the interest which they and the bodies they represented took in the Society and its activities. Finally, he made special reference to the presence of M. L. Gaymard, chief engineer of the Street Lighting Department of Paris.

Col. H. C. Smith, responding for the guests, in the course of a witty speech, had some shrewd digs at the electrical industry. The industry in which he was engaged, he said, was a very old one, and looked on electricity as a youngster, but he would like to remind Sir Henry Self that in the new incarnation this industry was no longer the same, and Sir Henry had better look out in the future! It must be admitted, he said, that the electrical industry had made great strides. There was a time when street lighting was all gas. After a time electricity began to come into vogue—just one of those little fads! Streets were lighted by both gas and electricity, and electricity had so improved that he believed the dual arrangement was good. but there was one thing that was almost certain. If one took a friend down a street and noticed suddenly that he appeared to have been overtaken by a serious illness, one could be sure that the lighting was not gas! Commenting on the presence of representatives of ophthalmologists and opticians, he said he had not noticed, in the days when gas was used for street lighting, that it was necessary to consult these, but he would not say which was the cause and which was the effect! On behalf of all the guests, however, he cordially thanked the Society for the hospitality they had received.

I.E.S. Lectures to School Children

The standard I.E.S. lecture to school children is proving very popular with educational authorities in many parts of the country. Some six sets of demonstration equipment are now in use and one I.E.S. Centre has had conspicuous success with its lectures which have now been given to nearly 3,000 children.

During the session beginning next October it is anticipated that a record number of lectures will be given.

SPORTS LIGHTING

by D. E. Beard

A review of the visual tasks and lighting requirements

The subject matter suggested by the title is considerable, and the scope of this article is necessarily restricted. The visual tasks encountered in both indoor and outdoor sports, and the resulting lighting requirements, are dealt with in some detail, and recommendations for some of the more popular sports are included.

Indoor sports considered are badminton, billiards, boxing and table tennis. Outdoor activities dealt with include football, tennis and race tracks.

Introduction

We are a nation of sport lovers, and from our earliest years games of one sort and another have taken a large place in our everyday lives.

Schools include competitive games and indoor and outdoor sports as part of their normal curriculum, whilst in some schools and at universities whole afternoons are devoted to outdoor games.

The average business man or woman, whether player or spectator, cannot normally afford a half-day in the middle of the week to pursue his or her favourite outdoor sport, and such activities are usually limited to week-ends. In the winter months this "week-end only" play curtails the interest of spectator and player alike, and, in the case of the latter, strictly limits time for practice.

A certain amount of experimental work was carried out before the war by various manufacturers in conjunction with sports associations, and a flood-lighting installation at the White City Stadium at the end of 1932 aroused considerable interest.

Sports associations have been wary in their approach to the subject of lighting, and in 1930 the Football Association banned its members from taking part in games played under artificial light. Improved lighting technique, however, will, it is hoped, encourage Association interest.

The war years, of course, put a stop to further development work, and the post-war problems and preoccupations have left little room for reopening this all important subject. To-day,* faced with a shortage of electricity and a very tight control in its use, development work must, of course, be limited, and new installations have, in the main, been in the field of greyhound and speedway racing tracks.

Thus we now find ourselves with new and efficient light sources at our command, floodlighting technique vastly improved, but still with our outdoor sports activities limited to the day-light hours.

In contrast to our own slowness in using artificial illumination for outdoor sports, the Americans have made great strides, and evening games of football, baseball, tennis, etc., are a regular occurrence.

It is reported that one of the foremost professional association football clubs recently visited the U.S.A., where they played football under an American floodlighting installation. The players reported conditions as "better than playing under England's natural winter conditions," and that lighting has been perfected for both players and spectators. It is understood that a scheme is already being planned for the flood-lighting of a ground in the North of England.

The installation and maintenance of a good outdoor installation, particularly for sports such as football, will be costly, and will depend directly on the number of spectators likely to attend.

The development of the fluorescent tubular lamp in recent years has provided the sports lighting engineer with a new and useful addition to the range of available light sources, and for indoor sports in particular the applications are numerous. The various indoor sports associations are very hesitant in accepting fluorescent lamps for games lighting, and complaints of glare

* This article was written before the recent relaxation on exterior lighting.

and stroboscopic effects are fairly common.

Too much stress cannot be laid on the necessity for carefully planning any installation utilising these new sources, and much harm has been done by their careless application. The advice of a qualified lighting engineer should be sought on any new sports lighting installation, and early co-operation between players and lighting engineer will help to provide the high standard of lighting required for indoor sports.

Cinemas, theatres and dance halls claim their full share of our evening leisure hours, but still a large number of the younger generation are on the streets after dark. Sports clubs are increasing in number and good sports lighting can materially assist in improving the nation's health by increasing the average time spent in games, and will also reduce juvenile delinquency.

General Assessment of the Visual Task

Brief consideration must be given first to the assessment of any visual task. How do we locate an object?

The human eye is able to detect an object by the contrast it presents to its background, and the amount of light required depends entirely on the ratio between object and background brightness. For example, the black print of our daily newspapers presents a sharp contrast to the white paper on which it is printed, and the type can be kept relatively small with comfortable perception. The effect is greatly altered, however, if a grey paper is used, larger type and/or increased illumination becoming necessary. The brightness of an object or its background is the product of the illumination received by it and the reflection factor of the substance of which it is made; control of this ratio at once becomes necessary for any visual task. Consideration must also be given to the duration of the seeing task and the necessity for speed in discerning the location of an object.

In sports lighting, we are at once confronted with an entirely new set of seeing conditions, and factors normally considered as constants in other fields are now variables. These can be summarised as follows:—

(a) *Object, size, location, path and speed of travel.*

The actual object size may vary from a small table-tennis ball to a rider in a speedway match. The apparent size (angle subtended at the eye) will change rapidly as the object moves in course of play.

The location of the object in most games will be constantly changing in a three-dimensional space, and the path to or from the observer will also change rapidly.

The speed of travel of the object will also be subject to wide variations in most games.

(b) *Background brightness.*

The background to be considered for many sports includes all surfaces or spaces both above and below a player's position as well as those on all sides of it. The object of regard may need to be followed in its flight against a varying background of overcast sky, relatively dark grandstand, or the variegated sea of multi-coloured spectators' clothing.

(c) *Observer locations.*

Consideration must be given to three observer groups — players, officials and spectators. Players and officials will be moving in undefined paths and at varying speeds, and spectators may be situated anywhere within a 360-deg. horizontal plane above, below, or on a level with the object.

Lighting Requirements

Quality of Light.

To fulfil the requirements of the visual task, we must endeavour first to control the brightness of the object and its background in such a way that the object remains clearly visible regardless of size location, velocity or path for any possible observer locations.

In attempting to achieve the desired control of brightness ratios, care must be taken to avoid glare; light sources should be so placed that no observer looks at or near the source during play. If this cannot be achieved, then the intensity in the direction of the observer must be as low as possible.

A sufficient number of carefully located lighting units should be planned to provide illumination on to the face of the object from at least two different

directions for any of the many possible observer locations.

An object passing quickly from a light to a dark area will appear to accelerate, and vice versa. Skill of play in many games is dependent on the the player's ability to assess accurately the speed and trajectory of the object, and it is therefore essential to provide uniform illumination in the three-dimensional area of play.

Quantity of Light.

Quantity of light will vary for various sports, and will depend on the following three main factors:—

(1) Brightness ratio (contrast) of object of view to background.
(2) Speed of play (professional, club or recreational, etc.).
(3) Distance of object from observer and resultant size of object (angle subtended at the eye).

Provisional recommendations for sports dealt with in the paper are given in Table I. They are based on the factors set out above and on current practice both in this country and in America.

TABLE I.

Recommended Illumination Values

	lm./sq. ft.
INDOOR GAMES.	
Badminton	
Tournament	20
Recreational	10
Billiards	
Tournament	30
Club	20
Recreational	15
Boxing	
Championship ...	300
Professional	200
Amateur	100
Table Tennis	
Tournament	50
Club	30
Recreational	20
OUTDOOR GAMES	
Football	
Professional	40
Amateur	20
Race Tracks	
Dog tracks	20
Speedway	30

Summary of Lighting Requirements

To fulfil the requirements set out in the preceding paragraphs, diffuse illumination, such as that provided by an overcast sky, is considered to be of excellent quality for sports.

Indoors, an indirect or semi-direct lighting installation with high reflection ceiling and upper walls will enable the lighting engineer to control background brightness.

The problems of control of background brightness, etc., with outdoor sports are much more formidable. Indirect lighting is impossible, and the provision of a large number of overhead direct lighting units can be considered impractical for the following reasons:—

(a) Fittings on suspension wires tend to swing and cannot be rigidly mounted,
(b) Glare is likely to be experienced when following the object of play in upward flight and viewit against the background of a lighting unit,
(c) Daytime appearance and possible obstruction caused by fittings, and
(d) Mechanical protection and maintenance.

The normal method employed, therefore, for lighting any large outdoor sports arena is the use of a sufficiently large number of direct floodlight units mounted outside the playing area, and located and focused to fulfil the basic requirements of—

(1) Uniform illumination in a three-dimensional space up to heights of 40-50 ft. for games such as football.
(2) Absence of glare for both players and spectators.
(3) Directional quality to provide illumination on the face of the object from at least two different directions for any object or observer location.
(4) Maintenance facilities for re-lamping, etc., and
(5) Mechanical protection.

Indoor Sports

Badminton.

Badminton, whether played indoors or outdoors, must be considered as an aerial sport. The game requires that players look toward the ceiling during a large part of the playing time, and special consideration must therefore be given

to ceiling brightness and the brightness and location of lighting fittings.

The shuttle or bird used in play normally has a high reflection factor (around 80 per cent.), and to ensure comfortable brightness ratios a dark background for both floors and walls is recommended. Dark green, with a reflection factor of approximately 20 per cent., is considered suitable for walls. A minimum ceiling height of 25 ft. is desirable, and upper walls should provide high reflection factors to assist in light diffusion and uniformity [1]. To reduce excessive brightness contrasts in the ceiling area, low brightness lighting units should be used, and these should be erected outside the court area.

Players' attention is centred mainly in the net area, and lighting fittings are

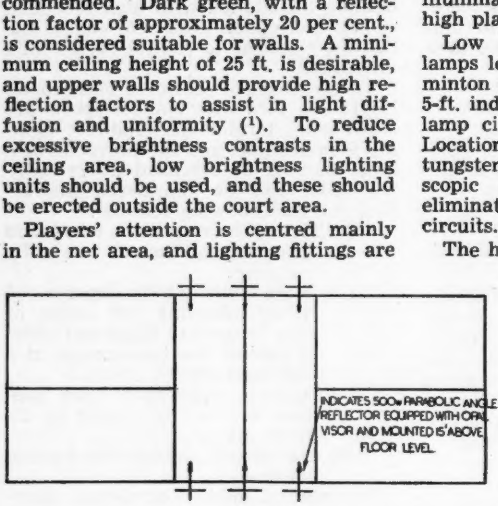


Fig. 1. Layout of typical lighting installations for badminton courts.

often grouped at either end of the net. Plans of typical installations shown in Fig. 1, utilise (a) parabolic angle reflectors with opal visors and 500-w. filament lamps at a mounting height of 15 ft., and (b) pairs of 80-w. twin lamp fluorescent units mounted at 15 ft. and 16 ft. The mounting height of these fittings could, in the author's opinion, be increased to 20 ft. or 25 ft. with advantage.

Another method [2] utilises a special diffuser type of lighting unit, mounted opposite the ends of the net and 9 ft. above floor level. The fitting utilises 3 x 200-w. filament lamps behind a distributing glass cover, and illumination is provided both upward and downward. The upward component serves in this case to illuminate the underside of the shuttle in high play.

Low brightness fluorescent tubular lamps lend themselves at once for badminton court lighting; 2-lamp or 3-lamp 5-ft. industrial units, incorporating twin lamp circuits, should be satisfactory. Locations should be the same as for tungsten filament lamp units and stroboscopic effects would be practically eliminated by the use of the twin lamp circuits.

The high speed of play involved calls for rapid assessment of the object location and flight, and intensities of 20 lm/sq. ft. for tournament play and 10 lm/sq. ft. for recreational play are considered reasonable.

Billiards and Snooker

These games do not involve fast play with rapid change of object and observer location, and lighting requirements are very different from those for other games. The visual task involves accurate assessment of object location from observer locations anywhere within a 360-deg. horizontal plane about the object, and a clear view of objects and playing area is essential. The object of play may present a slightly glossy surface, and care must be taken to avoid reflected images of the light source. The familiar green-topped billiard table provides an excellent background for play, and object/background brightness ratios are high.

Lighting requirements may be summed up as follows:—

(1) Provision of uniform diffuse illumination over the entire table area.

(2) Absence of harsh shadows.

(3) Absence of direct or reflected glare.

(1) Badminton Association of England.
(2) Sports Lighting, by M. W. Pierce, G.E.C. Journal, August, 1934, p. 181.

(4) High playing area/surround brightness ratio, to focus attention of players and spectators alike on to the playing area.

For normal recreational or home play, intensities of 15 lm/sq. ft. can be considered adequate, but for club and tournament play involving more sustained vision, values of 20 and 30 lm/sq. ft. are recommended.

Diffuse illumination with reasonable uniformity throughout the playing area is essential in order that object brightness may remain constant for all object or observer locations. Bright light sources should be suitably screened, to prevent any observer (player or spectator) from looking directly at them.

The brightness ratio of playing area / surrounding room areas should be kept at a high level in order to focus attention on the table, but care must be taken to avoid eye fatigue by excessive contrasts. As a general rule, average room illumination values should not fall below 4 lumens/sq. foot for recreational play, 4-5 lm/sq. ft. for club play and 6 lm/sq. ft. for tournament play.

Various designs of lighting fittings are available, and most of these consist essentially of a deep canopy between 8 and 9 feet long and 2 ft. to 2 ft. 6 in. wide. Three or four filament lamps, usually of the 150-watt inside-frosted type, are used, and these are normally spaced at intervals along the shade and cut off from direct view by suitable vertical baffles. Another type of fitting utilises two 150-watt lamps mounted well up in each end and separated by a carefully designed V-shape baffle. The inner surfaces of canopy fittings are normally finished in matt white to provide maximum diffusion.

A number of trial fluorescent lighting installations have been put into use with widely differing results. A lot of harm has been done by careless use of these lamps. Attempts have been made to use them in fittings designed for filament lamps with somewhat disastrous results.

The fluorescent lamp can claim two big advantages:—

(1) Greatly reduced operating temperature when compared with the filament lamp, and

(2) Low surface brightness.

The first of these factors is most important in billiards with fittings mounted only two or three feet above the table, and the second factor assists materially in reduction of glare when used in suitable fittings. Stroboscopic or flicker effects from these lamps can be overcome by the use of twin-lamp circuits.

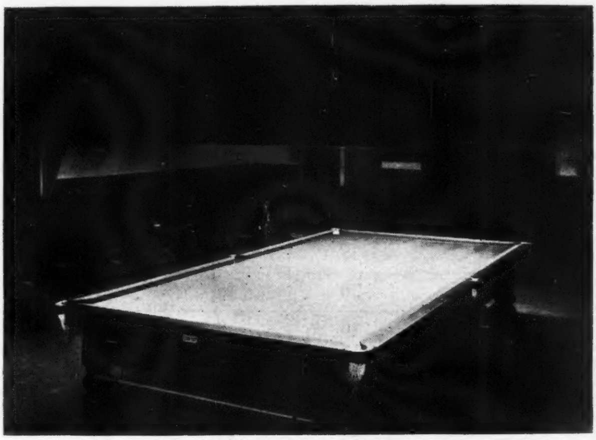


Fig. 2. Billiard table lighting with fluorescent lamps.

For comparison purposes, details are given of two installations, one using a modern filament lamp fitting, and the second using two standard fluorescent industrial lighting units.

With the filament lamp fitting the shade is divided into two pyramid-shape sections and the light sources are completely cut off from all normal viewpoints. The shade in this case is mounted 30 inches above the table.

Illumination readings taken on this table are given in Table II.

Figure 2 shows a table illuminated by two 5-ft. fluorescent industrial trough units, mounted across the table on 6-ft. centres and 3 ft. above it; photometric data are also given in Table II.

An American method utilises two 4-ft.

twin-lamp fluorescent fittings mounted end to end over the centre line of the table, and approximately 6 feet above it. Fittings are louvred to prevent glare, and twin-lamp circuits will, of course, eliminate stroboscopic effects. No illumination values are quoted for this installation, though a fairly accurate indication can be gained from the figures given in Table II for a similar unit at heights of three, four and five feet above table. Uniformity of illumination will, of course, increase with greater mounting heights, though actual illumination values will be reduced.

Installation No. 1 shows the greatest degree of uniformity, and attains a diversity factor of a little over 3 : 1. Installations Nos. 2 and 5 show diversity factors of approximately 6 : 1, and this factor could be still further reduced for installation No. 5 by increasing the mounting height to six feet.

For club play, etc., and where electricity costs are high, a fluorescent installation using standard industrial lighting fittings will be quite acceptable, and methods (2) or (5) are advised, though louvres may be necessary for installation (5).

The advantages of low temperature and low brightness with fluorescent lamps are likely to lead to their increasing use in billiard table installations. Fittings should be specially designed to accommodate these lamps. The 2 ft. 40-watt lamps, with a light output approximating to a 100-watt filament-lamp offers distinct possibilities for incorporation in a specially designed shade similar in characteristics to that used in installation (1). Lamps should be installed in pairs on twin-lamp circuits to eliminate stroboscopic effects.

TABLE II.

Illumination values (lm/sq. ft.) on a billiard table (12 ft. x 6 ft.) under various forms of electric lighting.

	(1) Special shades using 4 x 150w. filament lamps	(2) 2 x 80w. fluorescent Ind. trough reflectors across table (6 ft. centre) and 3 ft. above it	Twin lamp 40w. fluorescent fittings end to end over centre line of table		
			(3) 3ft. above table	(4) 4 ft. above table	(5) 5 ft. above table
Table centre ...	38	30	72	49	44
Centre Pockets	20	15	27	22	20
Corner Pockets	16	8	4	5	6
At table end (on centre line) ...	30	15	9	9	10
3 ft. from table end (on centre line) ...	50	50	58	38	26
ELECTRICAL LOADING (WATTS) ...	600	180	200	200	200

Figures for installations 1 and 2 were obtained from actual light-meter readings.
Illumination values for installations 3, 4 and 5 are calculated by plotting the iso-foot-candle diagrams.

Boxing

Boxing matches, championship, professional or amateur, are normally attended by large numbers of spectators. The lighting requirements which may vary for different halls are briefly as follows:—

(1) High-intensity glare-free illumination evenly distributed over the ring area only.

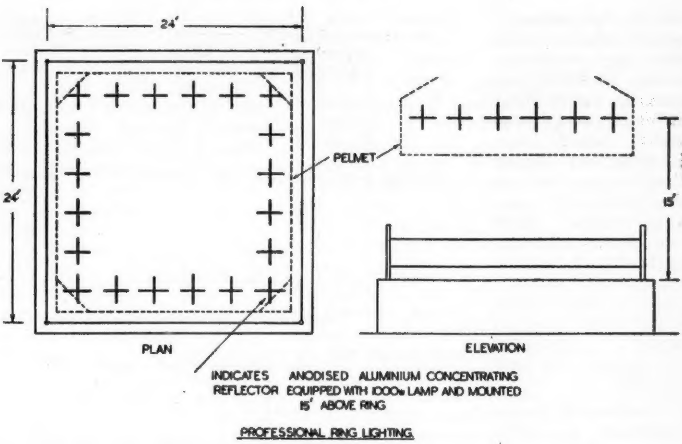


Fig. 3. Lighting lay-out for professional boxing ring.

(2) Bearing in mind that the quantity of light will depend on (a) distance and location of most distant observers, and (b) class of fight (championship, professional or amateur), values of 300 lm/sq. ft. (championship), 200 lm/sq. ft. (professional) and 100 lm/sq. ft. (amateur) are considered reasonable.

(3) Height and design of lighting fittings above the ring must be determined by angle of view of spectators situated in a 360-deg. horizontal plane above, or below, the ring level.

Special rectangular fittings housing a large number of high-wattage lamps in concentrating reflectors are normally employed; a deep curtain or pelmet is fixed at the lower edge of the fitting and acts as a cut-off from the light sources and assists in limiting the high-intensity illumination to the ring area. To increase object/background-brightness ratios and to focus attention on the ring area, auditorium lighting is normally dimmed or switched out during bouts.

The lay-out shown in Figure 3 provides an intensity of approximately 230 lm/sq. ft. at a height of 4 ft. above ring level and should, therefore, prove satisfactory for professional matches.

Fittings should be provided with facilities for easy erection and removal, and with suitable switching arrangements to permit the use of all or only some of the lamps provided.

Table Tennis

The Sports and Recreational Area Lighting Committee of the American I.E.S. recently carried out most extensive tests on table tennis lighting and their report has recently been published(3).

In this game a small white ball between 11.43 cm. and 12.06 cm. in circumference has to be followed in rapid play over a table 9 ft. x 5 ft., and throughout a playing area varying from the table area only for purely recreational play, to an area 12 metres x 6 metres x 3 metres high for world championships.

Requirements in regard to uniform illumination and freedom from glare apply as in other games. Light, however, should be directed on to the face of the ball from behind the player to increase the brightness of the half-ball nearest him as it approaches.

Tests show(3) that at illumination values below 20 lm/sq. ft., playing performance substantially deteriorates. Sufficient illumination will reduce concentration on seeing and will permit a player to observe his opponent's play and calculate his tactics. Minimum values of 20 lm/sq. ft. are advised for purely recreational play, with increased values of 30 lm/sq. ft. for club play and 50 lm/sq. ft. for tournament play.

Upper walls and ceilings of rooms in

(3) Study of Table Tennis Lighting. "Illuminating Engineering," Vol. XLIII, No. 3, March, 1948, p. 251.

which the game is played should provide high reflection values of 60-80 per cent. to assist light diffusion, and lower walls should have a reflection factor similar to that of the table itself, usually around 20-30 per cent. Lighting units should provide reasonable illumination on ceilings and upper walls to avoid sharp brightness contrasts in the field of view.

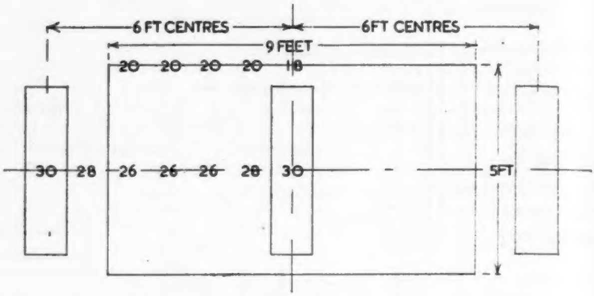


Fig. 4. Table tennis installation using fluorescent lamps.

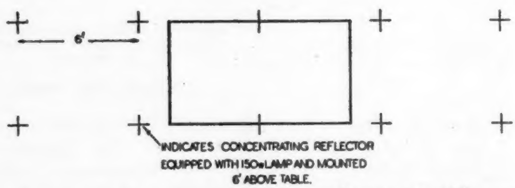


Fig. 5. Layout of tungsten lighting installation for table tennis.

Fluorescent lamps installed in twin lamp fittings with the normal twin lamp circuit and placed across the table should prove quite satisfactory for normal recreational and club play. In the American tests no stroboscopic effects were detected in fluorescent installations providing 55 lm/sq. ft., though below these intensities flicker was observed in high-speed play.

For normal club play an installation of three twin 4 ft. fluorescent industrial lighting units, mounted 5 ft. above the table and across it on 6ft. centres, will provide fairly uniform illumination of 30 lm/sq. ft. at the table centre with 20 lm/sq. ft. at the edges. (Fig. 4.) This will need to be supplemented by additional fittings in the run-back area for more skilled play. Cut-off of fittings used should be in the region of 60-65 degrees to prevent glare.

A satisfactory tungsten lamp club installation is shown in Fig. 5, where pairs of 150-watt lamps in concentrating reflectors are spaced 6 ft. x 5 ft. and 6 ft. above table.

It is reported that an installation using 4-ft. fluorescent lamps, mounted end to end in deep recessed trough reflectors on 4-ft. centres, and wired on twin lamp circuits, gives average illumination on the table of about 50 lm/sq. ft. with a minimum of 47 lm/sq. ft. No stroboscopic effects are reported for this installation, and it is considered suitable for skilled as well as recreational play.

For recreational play, three 150-watt inside frosted lamps in suitable shades will provide adequate illumination. Deep cone parchment paper shades are considered excellent for this purpose.

For championship play, however, involving a minimum mounting height of approximately 10 feet, special canopy type fittings incorporating a number of high wattage filament and mercury discharge lamps, housed in deep dispersive reflectors, are normally used. These units are usually placed about 20-25 ft. above the players and provide what might be considered as optimum conditions for seeing. Illumination values of 100 lm/sq. ft. are quite normal for this type of installation.

Outdoor Sports

Football

In the early 1930's interest was being aroused in this country by the possibility of matches by night under artificial illumination, and a number of grounds had installed lighting for practice purposes. In December, 1932, an installation of floodlighting was completed at the White City Stadium and the Football Association relaxed its previous ban on

games under artificial illumination to permit a match under this new lighting.

The visual task in football involves a dark coloured object (ball) normally with a low reflection factor, which has to be seen in movement through a three dimensional space against varying backgrounds of field, grandstands, spectators' or players' clothing or overcast sky, etc. Observers may be players with rapidly changing location, or spectators in a fixed location anywhere within a 360-degree horizontal space above, below or on a level with the object.

The lighting requirements involve glare-free uniform illumination of the entire playing space up to a height of 40-50 feet. with careful siting of lighting units to provide illumination on the face of the ball from two or more directions for any observer or object location.

In the U.S.A. floodlighting units are grouped along the side of the playing area and directed across the players' main field of vision. No fittings are used at the ends of the field behind the goal area.

Figure 6 shows a plan view of the White City Stadium installation in which four groups of floodlights were located at the corners of the stadium behind the spectators.

The four towers were constructed of angle sections bolted together and specially designed to minimise the effect of wind pressure. The height of the towers was 115 ft., and 36 narrow beam floodlight fittings, each using one 1,000-w. class B projector lamp, were secured to each tower. The installation provided a vertical illumination of 14 lm/sq. ft., and an average horizontal value of 5 lm/sq. ft. on the field of play.

The height and location of the lighting fittings in this installation should fulfil all three lighting requirements detailed in the preceding paragraphs.

The quantity of illumination to be provided in any particular installation is directly related to (a) the class of game (professional, amateur, etc.), and (b) the distance of the back row of spectators from the side-line nearest to them. This second factor will normally bear a direct relation to the number of spectators capable of being accommodated, and this in turn will depend on the class of match for which the ground is normally used.

Suggested levels of illumination given earlier in this article should be taken as a guide only, the actual requirements depending on the factors set out above.

Tennis

Lighting requirements for tennis are similar to those for football, with the difference that the object ball is much smaller and usually moves more quickly. Uniform illumination is required in a three-dimensional space, and lighting

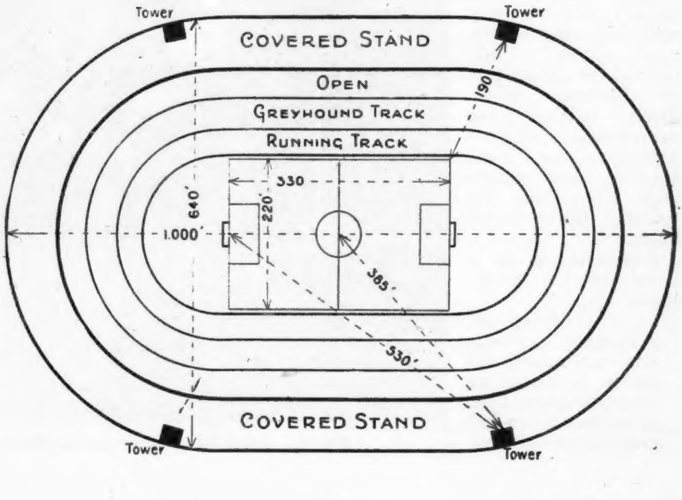


Fig. 6. Plan of the White City Stadium showing the various tracks and the lighting towers.

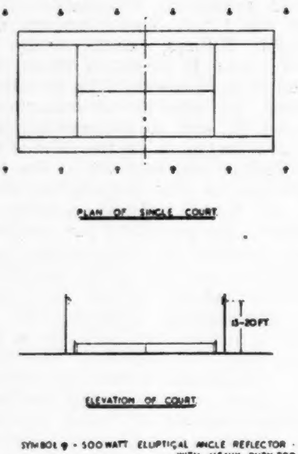


Fig. 7. Layout for lighting an outdoor tennis court.

fittings should be located outside the playing area.

Fig. 7 shows the lay-out of a typical installation using 500-w. lamps in elliptical angle reflectors at 15—20 feet.

Similar installations with modifications could be used for outdoor badminton courts.

Track Lighting

On account of their shape dog racing and speedway tracks are often built around the perimeters of football fields. Their lighting requirements must, however, be considered quite separately from those for lighting the football fields.

Requirements of a track lighting installation are:—

1. Illumination of reasonable intensity and uniformity up to a height of approximately 3 ft. (greyhound tracks) and 5 ft. (speedway).
2. Complete absence of glare for both riders (speedway) and spectators in all locations.
3. Freedom from obstruction by poles, etc., for spectators' view of football area.

In this country cut-off fittings providing a wide two-way distribution (max. c.p. at 50—60 deg. from the vertical) are normally used for greyhound tracks. Fittings are usually mounted 18—20 ft. above ground level, spacing being such as to provide a maximum diversity factor of 2:1. Uniform illumination is essential.

For speedway tracks a third or forward component of light is provided across the track in view of the greater track width and lower reflection factor. Poles supporting fittings should normally be placed outside speedway tracks both for mechanical protection and to avoid obstruction to the riders.

Fig. 8 shows an excellent example of cut-off lighting, using 750-w. lamps at a height of 15 ft. and spaced at 20 ft. centres.

Conclusions

As indicated at the beginning of this article, the scope of the subject of sports lighting is almost unlimited, and much could be added on the lighting of swimming pools, indoor tennis courts, squash courts, gymnasiums, etc.

(*Continued on page* 157.)

Fig. 8. Track lighting, using cut-off fittings.

Some New Terms in Photometry and Illumination

THE CANDELA

As readers of lighting literature will have noticed, the term "candela" is now coming into use to denote the unit of luminous intensity. This originated at the meeting of the International Commission on Illumination in Paris last year and some explanation of the circumstances which led up to its adoption may be of interest to readers of LIGHT AND LIGHTING.

For many years the standard of light was a wax candle, more or less loosely specified, and the unit of luminous intensity was therefore, not unnaturally, known as "the candle." Further, the statement that a source had a candlepower of "umpteen" meant that its luminous intensity was "umpteen" times that of a standard candle. Unfortunately, what was called a candle in English-speaking countries was called a "bougie" in French and a "Kerze" in German and the corresponding units were the "bougie décimale" and the "Hefnerkerze."

Some unification of magnitudes was achieved by the national standardising laboratories in 1909 and endorsed by the I.C.I. in 1921, but this did nothing to overcome the diversity of names nor, in fact, did it include the German unit.

Such was the position until 1939 when the Consultative Committee on Photometry of the Comité International des Poids et Mesures (C.I.P.M.), the international body originally set up to regulate standards of length and mass but later extended in scope to cover electrical, photometric and other standards, recommended a new unit of luminous intensity to supersede both the so-called international candle of 1921 and the German Hefnerkerze. This new unit was defined in terms of the brightness of a full radiator (the so-called "black body") at the temperature of solidification of molten platinum and was given the name "new candle" in English, with corresponding translations in the other languages, viz "bougie nouvelle" and "neue Kerze." Although the Committee on Photometry recommended that the date of adoption of this new unit should be January 1, 1940, the outbreak of war prevented the recommendation from taking effect and it was not until January 1, 1948, that the new candle came into general use (see LIGHT AND LIGHTING, July, 1947).

At the meeting of the I.C.I. last year it was pointed out that the lack of a single international name for the unit of luminous intensity was a serious inconvenience, especially in those countries where more than one language was in current use. The Belgian delegation put forward the proposal that the name of Bouguer, the pioneer of photometry, should be adopted universally for the unit of luminous intensity, but for various reasons this was found unacceptable and finally the name "candela," the Latin word for candle, was recommended. This recommendation was adopted by the Comité Int. des Poids et Mesures last October and there is no doubt that it will come into general use within a short time.

There are several matters which arise from the adoption of a name of this kind. The abbreviation *cd* has been settled internationally by the C.I.P.M. but the pronunciation is less easy. Probably it will be agreed to accent the second syllable, as in the case of the Latin word. The form of the plural, too, calls for consideration. The Latin is candelae and the Italian candele, but candelas has already been used officially in Belgium and will probably be used in France. It will almost certainly be preferred in this country and in America, where candelae would be deemed pedantic.

There remains the problem of the names to be used for the derived units. The lumen is already international and the only change necessary will be the omission, in due course, of the adjective "new." The same applies to the metric or c.g.s. units of illumination and brightness, viz. the lux and the stilb, for the

metre-candle is very little used. The lambert, millilambert and foot-lambert are also unaffected and the only difficulty arises with the foot-candle. As this unit is in no sense international, its use being confined to English-speaking countries, there seems to be no reason why the name should not be retained without alteration of form until it finally gives place to the more self-explanatory "lumen per sq. ft."

LUMINANCE, LUMINOSITY AND LUMINANCE FACTOR

The White Knight (referring to the occasion on which he became wedged in the helmet of his own invention): " . . . it took hours and hours to get me out. I was as fast as—as lightning, you know."

"But that's a different kind of fastness," Alice objected.

The Knight shook his head. "It was all kinds of fastness with me, I can assure you!" he said.

"I don't feel very bright this morning; not more than one foot-lambert."

"But that's a different kind of brightness."

"And so it is when you speak of a bright colour or a bright day; in fact, the word 'brightness' is seriously over-worked and no doubt Humpty Dumpty would have considered that it should be paid extra."

When we look at a surface which is emitting light it appears to us brighter or less bright than some other surface; but by just how much we cannot say. As Lambert pointed out in 1760 the only relation between brightnesses which the eye can evaluate is that of equality. On the other hand it is a comparatively easy matter to measure the light emitted from a given area of any surface and so to evaluate the brightness in physical terms. To put the matter shortly, we cannot measure the sensation which we experience when we look at a surface, but we can measure the physical cause of that sensation.

Unfortunately both the sensation and the physical cause have in the past been denoted by the term "brightness" and this has led to much confusion of thought and, occasionally, to erroneous reasoning.

On account of considerations such as this, colorimetrists on both sides of the Atlantic have for some years past attempted to introduce two separate words to denote the two conceptions, calling the physical cause, or stimulus, "luminance" and the sensation produced "luminosity." The former of these terms was adopted at the I.C.I. meeting in Paris, but the term to be used for the sensation was left undecided. However, the illuminating engineer has probably more to do with the physical quantity and it is a distinct gain to have a special word for this.

In future, therefore, the quantity expressed in candelas per square inch or in foot-lamberts must be referred to as luminance and not as brightness. Similarly, glare limitation will be achieved by, among other things, restricting the luminance of any bright object in the field of view. It will be noticed that in the last sentence the word "bright" is used quite generally and does not refer specifically to the physical quantity.

While the word "luminance" was adopted for both the French and English languages, an equivalent in German was not considered. In fact two distinct words had already been in use for some considerable time in German, viz., "Helligkeit," derived from the perfectly general word "hell," to denote brightness, and "Leuchtdichte," to denote the physical quantity, and, therefore, exactly equivalent to luminance.

The use of a special word to denote the brightness sensation is sometimes desirable, especially when it is necessary to make clear precisely what is intended as, for example, in the sentence "at low values of brightness, surfaces of different colours which are equal in luminance may have quite different luminosities." As an alternative to luminosity, the term "subjective brightness" has been proposed. This may appear clumsy, but it has the merit of being self-explanatory. It is, perhaps, unfortunate that the term luminosity has already been used for many years in the term "luminosity factor," which denotes the ratio of luminous flux to energy flux, more especially as a new term "luminance factor" was introduced side by side with luminance to denote "the ratio of the luminance of a body, under specified conditions of illumination and observation, to the luminance of a non-absorbing perfect diffuser receiving the same illumination." In other words, if the luminance

of a certain portion of the wall of a room, for instance, is *W* foot-lamberts and if a plate covered with magnesium oxide (assumed to be a perfect diffuser with a reflection factor of 100 per cent.) when placed over this part of the wall is found to have a luminance of *M* foot-lamberts, the luminance factor of the wall is L/M for the particular conditions of illumination and for the particular direction of view adopted. The symbol adopted to denote the luminance factor of a surface was β. It will be seen that the value of β may often be quite large. For instance, in the case of the bright streak produced on a road by the obliquely incident light from a street lamp, β may well be 20 to 30 or, in the case of a wet road, several hundreds.

SPORTS LIGHTING

(*Continued from page* 154.)

The next few years should see big developments in lighting for both indoor and outdoor sports, and these developments may well call for a special study to be made of the subject.

The author acknowledges indebtedness to the following companies, associations, and individuals who have provided information and photographs, etc.: The Benjamin Electric, Ltd.; the Brighton Lighting and Elec. Eng. Co., Ltd.; the British Thomson Houston Co., Ltd.; A. Dean and Co., Ltd.; the General Electric Co., Ltd.; V. and N. Hartley, Ltd.; Metropolitan-Vickers Elec. Co., Ltd.; Philips Electrical, Ltd.; the Illuminating Engineering Society of America; the Electric Lamp Manufacturers' Association; the Badminton Association of England; the Lawn Tennis Association; the Billiards Association and Control Council and Mr. W. T. Lampard; Willey and Co., Ltd.; the Table Tennis Association; Mr. Ivor Montague, and the Football Association.

Corrigenda

It is regretted than an arithmetical error appears in Table 5 of the article, "An Analysis of the Lighting Problem of an Industrial Undertaking," which was included in our April issue. The wiring cost for fluorescent lighting should have been given as £6,368 (not £7,368), and hence the annual capital charge for wiring as £318, giving a total annual charge of £1,365. This figure is again quoted in Table 9. Although this correction appears to enhance the case for fluorescent lighting, the author again wishes to stress the unimportance of these figures except to illustrate the method used.

Dr. Aldington, referring to the account of the exhibits at the Physical Society's Exhibition which appeared in our May issue, points out that the eight-strip selenium rectifier photo-cell mentioned on p. 114 was an improvement on his original rectifier photo-cell due to Mr. W. Harrison, of his laboratory.

PERSONAL.

Mr. J. C. Lowson and Mr. S. D. Lay will both shortly be taking up appointments with the Australian Department of Labour and National Service in Melbourne. Mr. Lowson is already on his way, and we understand that Mr. Lay will be following very soon. Both have taken great interest in I.E.S. matters, and we wish them every success in the future.

*

We note that Mr. George Grenfell Baines has been commissioned for work in connection with the South Bank site for the 1951 Festival of Britain.

*

Mr. Tom Jones, a past-chairman of the Liverpool Centre of the I.E.S. and managing director of Tom Jones (Electrical Engineers), Ltd., has been re-elected chairman of the Liverpool branch of the E.C.A. Mr. A. Winstanley, also on the Liverpool I.E.S. Centre committee, has been re-elected as vice-chairman.

*

Mr. M. E. Broadbent has been elected chairman of the Huddersfield branch of the E.C.A. in place of Mr. J. T. Thornton, who has been chairman since 1939.

Obituary

It is with deep regret that we report the death, on May 24, of Mr. Trevor Jones, a member of the Cardiff Centre of the I.E.S. Mr. Jones was district commercial officer of the Bargoed, Merthyr and Blackwood areas under the South Wales Electricity Board. Mr. Jones was taken suddenly ill and died on his way to hospital.

New Lighting Installations

Art Gallery Lighting

A fluorescent lighting system has been in operation in one of the sections at the Leicester Art Galleries, London, for some months, and it is now possible to assess the advantages of the method of illumination. The lighting scheme was planned by Mr. Ralph B. Giles, M.I.E.E., Consulting Engineer, Mazdalux fluorescent fittings were employed.

The original installation consisted of tungsten lamps mounted in pairs behind pelmets which served to direct most of the illumination on to the pictures. These pelmets were used for mounting the fluorescent lamps. The pelmets are situated 2 ft. 6 in. from the wall and project from the ceiling to a depth of 9 in.; they are fitted with a shield to reduce the light intensity above the pictures.

When this installation was being planned, the opinion of a panel of artists was sought with regard to the colour rendering of the fluorescent lighting. Experiments were carried out and it was decided to use a mixture of "daylight" and "warm-white" lamps.

Whilst adequate general illumination is obtained, there is an intensity of 20 lumens per sq. ft. on the paintings. This intensity has proved satisfactory from the point of view of the observer, and it is found that anything in excess of this figure detracts from the picture. The new installation has been favourably commented upon in art circles.

Factory Lighting

Fluorescent lighting recently installed in the sewing room of Messrs. Wathen, Gardiner and Co., clothing manufacturers, of Staple Hill, Bristol, gives an illumination of between 35 and 40 lm./sq. ft. on the working plane. The result is that needle-point illumination is extremely good and shadows are reduced to a minimum. Most of the work carried out in this sewing room is on black and dark blue uniform material which inevitably increases the risk of some strain on the workers' eyes. The new lighting installation has greatly improved working conditions.

The lighting scheme includes a number of trough reflectors, each housing two 80-w. fluorescent lamps The fittings are mounted in banks of three at approximately 13 ft. above floor level, in parallel

Fluorescent lighting at the Leicester Galleries, London.

The lighting in the sewing room of a clothing factory.

rows spaced 14 ft. apart. The installation was designed by the B. T.-H. Co., who provided the equipment.

☆ ☆ ☆

The lighting of the new Tecalemit factory at Plymouth is by Holophane "Correctalite" translucent enclosed reflectors, which provide a well-diffused illumination over the whole of the works area. The use of the translucent type of fitting eliminates the low ceiling or "tunnel" effect, often ascribed to opaque reflectors, and the light-coloured superstructure makes maximum use of the relatively small amount of light transmitted above the horizontal.

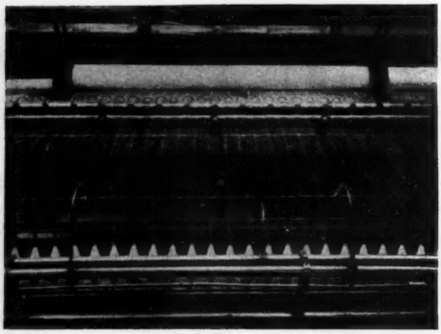
The "Correctalite" glassware gives sufficient colour correction to the light from the tungsten lamp to provide an effect nearer to daylight than is usually obtained with this type of light source.

With 300-w. lamps an even illumination of approximately 14 lm./sq. ft. is obtained under service conditions. The whole installation was planned by the Technical Service Dept. of the Holophane Company.

Tungsten lighting at the new Tecalemit factory.

☆ ☆ ☆

An extensive installation has recently been carried out at the new factory of Messrs. De La Rue Insulation, Ltd., on the Coast Road at Tynemouth, Northumberland. The factory is engaged on the production of laminated plastic sheet. The lighting includes fluorescent, tungsten, and H.P.M.V. lamps, and covers the factory roadways as well as the interior of the premises. All the installations were planned by Messrs. R. W. Gregory and Partners, Consulting Engineers, Newcastle-on-Tyne, in conjunction with the General Electric Co., Ltd.



A close-up photograph of the mule spinning operation at Albany Mills, Huddersfield, of Messrs. A. Lawton, which were recently relighted with fluorescent lamps by Ekco-Ensign Ltd. The illumination on the operation is 20 lm/sq. ft.

A total of approximately 470 slotted-top troughs, each housing one 5-ft. 80-w. fluorescent lamp, has been installed for general lighting to a level of 12 lm./sq. ft. In the Treating Bay the fittings have been mounted in a continuous line, angled owing to overhead obstructions, to light the input side of the impregnating machines; supplementary local lighting of the rollers by fluorescent lamps is also provided. At the output side of the vertical impregnators, fluorescent lamps mounted directly above the rollers provide very suitable illumination for the critical inspection of the product for depth and tone of varnish.

In the Press Bay, where automatic hydraulic presses operate, mixed tungsten filament and H.P.M.V. lighting is installed. Considerable trouble was taken to obtain the most suitable blend of light, and the final selection of pairs of 500-w. tungsten and 250-w. mercury lamps in separate G.E.C. Saaflux reflectors was made after tests and demonstrations had been carried out.

Bus Lighting

The Green Line double-decker experimental coach which has recently been put into service by the London Transport Executive is equipped with fluorescent lighting. The lighting fittings, which were supplied by Siemens Electric Lamps and Supplies, Ltd. to designs prepared by the C.A.V. Company, are made of moulded "Perspex" in the form of open troughs.

In all there are 18 fittings for interior lighting, nine in the upper saloon, eight in the lower saloon, and one on the platform, each accommodating one 18-inch 15-watt warm-white lamp. The illumination is a great improvement on that obtained from the normal tungsten lamp installation, and an average value of 7 to 8 lm./sq. ft. is obtained at reading level.

A C.A.V. invertor which operates from the 24-volt. battery supplies alternating current at a frequency of 400 cycles per second to the lamps. The weight of the invertor is 13 lb. and that of the container 20 lb.

To light the front and rear indicator panels single 2-ft. 20w. fluorescent lamps are employed.

Mixed tungsten filament and H.P.M.V. lighting in the Press Bay of a new plastics factory.

I.E.S. ACTIVITIES

Glassworks Visits

A party of 20 members from different parts of the country took part in a visit to the glassworks of Messrs. Chance Bros., at Smethwick, on May 24. On arrival at the works the party was entertained to lunch and welcomed by Mr. H. S. Martin. Dr. W. M. Hampton, a former vice-president of the Society and a director of Messrs. Chance Bros., was unfortunately unable to be present, being at that time in Scotland at a technical conference.

After lunch the party split into small groups to tour the works. Amongst processes seen were the various steps in the manufacture of lenses for lighthouse projectors, blowing bulbs, including those for cathode ray tubes and the blowing of opal glassware. One surprising thing learned by those taking part was that repairs to the furnaces, which operate at up to 1,600 deg. C., were carried out whilst the furnaces were still in use. The party also saw the rolling of sheet glass and reinforced glass.

All taking part agreed that it was a most enjoyable and instructive visit, even though it may have been somewhat strenuous, and Professor J. T. MacGregor-Morris expressed to Messrs. Chance Bros. the thanks of the Society for allowing the I.E.S. to pay an official visit to the works and for their excellent hospitality. Before leaving the works each member of the party was presented with a souvenir of the visit in the form of a pressed glass ashtray.

On the same day another small party of I.E.S. members visited the Osram-G.E.C. Glassworks at Wembley. At this works the processes are automatic. The party saw the manufacture, cutting, and grading of glass tubing by various processes, including the manufacture of tubes for fluorescent lamps, in which a high degree of accuracy is required. Bulb-making machinery was also seen whilst turning out lamp bulbs and inner tubes for vacuum flasks.

The party was entertained to tea, after which Mr. J. P. A. Drewry proposed a vote of thanks to Dr. J. E. Preston and his staff for their hospitality.

Liverpool Centre

The annual luncheon of the Liverpool Centre of the I.E.S. is an event which one can be certain will be a most enjoyable and well organised function. In addition it is an occasion which has a reputation for good speeches. The luncheon held at the Adelphi Hotel, Liverpool, on May 17, when the Rt. Hon. Lord Woolton, P.C., C.H., was the guest of honour was most successful, some 120 members and guests being present.

The toast of the City and Port of Liverpool was proposed by the President of the I.E.S. (Mr. J. M. Waldram) who recalled the part played by Liverpool as one of the most important ports of the country during the war. It was, he said, through Liverpool that a very large proportion of our food had been imported during those troubled times. He said that he had always had an admiration for the organisation behind our food supplies during the war and was particularly pleased on this occasion to meet the man who had been responsible.

The response to this toast was made by the Lord Mayor of Liverpool (Ald. W. T. Lancashire) who said he was very pleased to respond to the toast so ably proposed. He said that Liverpool had much to be proud of in its past and that its prosperity in the future was assured by the confidence of leading industrialists of the country who were planning great developments on Merseyside.

Lord Woolton then addressed the members. He said that according to the time-table only four minutes remained for him in which to give his address. This, he said, would be just about sufficient for him to say all that he knew about illuminating engineering—most of which he had learned from Mr. Waygood. He had at an early stage in his career been concerned with lighting and in the business with which he was concerned lighting was an important matter. He commented on the improvements in lighting made during recent years, which have been to the benefit of all concerned. In spite of the apparent high initial costs, better lighting, he said, paid for itself in the end.

Lord Woolton then said that his

Picture taken at the Liverpool Centre Luncheon on May 17, showing Mr. O. Waygood, Centre Chairman, Ald. W. T. Lancashire, Lord Mayor of Liverpool, Mr. J. M. Waldram, I.E.S. President and the Rt. Hon. Lord Woolton.

experience of lighting matters not being vast he would have to draw on his experiences in another field for the purpose of this address. He then spoke of the economic state of the country as seen by a business man connected with organisations whose success depends on the well-being of the people of the country as a whole.

He thought that ultimately this country would be restored to its former prosperity, but that the immediate future was anything but bright. We were a nation of traders and had been for generations, to the benefit of the whole world, and depended for our very self-support on our capacity to trade. At the moment, he said, we were increasing the number of non-producers both in the civil service and in private enterprise who were employed on unnecessary paper work so that the cost of administration and production was increasing. This had resulted in high taxation, taking from firms money which should be used by the firms to replace old and worn out machinery and to carry out other improvements in production.

The immediate effect of the resulting high cost of good was that overseas buyers just would not pay our prices and were looking elsewhere for their requirements—and many countries were now producing similar goods much more cheaply.

He pointed out that Marshall Aid could not last for ever and that unless people were prepared to do more work for the money they were now paid and helped in this way to reduce the cost of goods then we would face a very difficult situation when Marshal Aid came to an end.

Mr. O. Waygood, chairman of the Liverpool Centre, wound up the proceedings by thanking Lord Woolton for his address and expressing the appreciation of the Centre to the guests for their presence.

Cardiff Centre

The announcement of relaxation of restrictions on lighting for shop windows and display generally was considered by the committee of the Cardiff Centre to be a matter of some importance, and it was felt that, as so little had been done since 1939, it was a matter of urgent necessity to give those connected with the lighting industry, shop fitting and display, an opportunity of acquiring some knowledge of the current methods and applications of new light sources which have become available since 1939. The current session having almost terminated, steps were taken to provide a special meeting which would enable new ideas to be discussed and considered, and possibly put into operation by the early autumn in good time for the lighting season.

With the support of the South Wales Electricity Board and the Lighting Service Bureau arrangements were made for a large scale demonstration and lecture during the afternoon and evening of May 19. The afternoon meeting was held for those concerned with the technical aspects of the subject, and an audience of 120, composed mainly of members of the staff of the South Wales Electricity Board, and members of the Society, were given a first-class lecture, incorporating many new ideas and novel

suggestions. The evening session dealt rather more fully with the practical aspects and the audience was composed of display personnel of large stores and tradespeople generally. Those whose job it is to display goods of all types to the best advantage listened to, and saw, much that will give them food for thought when considering plans for next winter.

The lecturers at both sessions were Mr. W. Robinson and Mr. R. Tate, assisted by Mr. Johnson, all of the Lighting Service Bureau. The chairman was Mr. J. F. Smith, chief commercial officer, South Wales Electricity Board. The success of this joint effort was an indication of the value of such co-operative effort.

Manchester Centre

At their meeting on April 14 the Manchester Centre heard a lecture entitled "New Developments in Fluorescent Lighting," by Dr. J. W. Strange. The meeting was a joint one with the Institution of Electronics (N.W. Branch).

The lecturer gave a detailed description of the developments of various types of starting circuits as applied to tubular fluorescent lamps. Comparisons were given of the starting voltage required by each different set of conditions and the advantage gained by the use of the "quick-start circuit" in relation to the life and starting of the lamp. It was pointed out that where a large industrial installation was concerned a few seconds' delay in starting had no serious effect, but for domestic use in the home the delay is undoubtedly a disadvantage. Quick-start circuits controlling multiple tube operation were also included, showing the merits of this system in comparison with starting circuits incorporating glow and thermal switches.

A practical demonstration and relative data showing the dimming of fluorescent lamps was presented. The range of dimming for stage lighting was of such an order that it was now approved by the theatrical profession. Comparisons were given between the British colour standards of lamps and their American equivalents, and the trend towards warmer colours of 3,000K was noted.

The problems arising with the starting of the more recent additions to the range of lamps and their efficiences were given in detail, and the importance of compactness and lower initial cost to the consumer was emphasised.

The concluding section of the lecture touched upon the recent developments in regard to the use of Krypton as a filler gas. It was stated that prior to 1928 the price of this gas was £2,000 per litre but due to the present wide use of liquid air it is now possible to consider its use without an excessive increase in production costs. Experiments had been reported in 1939 but recent work in this field made this development one of considerable interest to the lighting industry. Comparisons between various combinations of gases were given together with details of the improved efficiency and lower operating temperatures of the larger lamps of 80 and 100 watts rating.

I.E.S. List of Members

It is now some years since the I.E.S. were able to print a list of their members. It is understood that an up-to-date list is to be printed shortly, and members are asked to notify the Secretary not later than July 31 if there is any change in the address to which communications are now sent.

Trade Notes

Cryselco, Limited, announce that their Brighton branch, office and stores, is closed from June 1, 1949, and new premises acquired and opened at 36a, London-road, Southampton, where comprehensive stocks are carried for the convenience of their South Coast clients.

The London office of the Metropolitan-Vickers Electrical Company, Ltd., has been transferred from Kingsway to St. Paul's-corner, 1-3, St. Paul's-churchyard, E.C.4 ('Phone: City 5757).

"FESTIVAL OF BRITAIN." The Council of Industrial Design have opened a 1951 stock list to which they invite manufacturers to send photographs or drawings of their best products. Address to Stock List, Council of Industrial Design, Tilbury House, Petty France, London, S.W.1.

The EDITOR Replies

Apropos the address given by Monsieur Gaymard at the annual meeting of the I.E.S., one of our correspondents says how refreshing it was to hear a street lighting engineer emphasise so strongly the necessity for freedom from glare and the importance of cut-off fittings in this respect. Monsieur Gaymard evidently regarded British practice as beng rather easy-going in regard to glare and, after motoring along certain arterial roads not far from London one might well agree with this impression.

It was also interesting, says our correspondent, to hear how much importance is attached, in Paris, to facilities for easy maintenance of the lighting fittings. The complete absence of globes shows a praiseworthy tendency to eliminate all extraneous glassware that might involve reduced efficiency, unless the most elaborate arrangements are made for cleaning. No doubt, says the writer, if Monsieur Gaymard had to deal with the atmosphere of some of our Midland cities he would find his globeless fittings impossible to maintain efficiently. Nevertheless, the ingenuity and freshness of the ideas put over by Monsieur Gaymard may well be a stimulus to those engaged on the revision of the British Standard Specification for street lighting.

Another correspondent describes a curious experience which he first noticed in a shop lavishly lighted by cold cathode fluorescent tubes. Normally, as he says, distinct vision is limited to a small central field of view, while objects in the surrounding field are seen less distinctly. He descrbes his experience as a reversal of this state of affairs and says, "a field of view rather more than the size of a half-penny at a foot distance becomes completely blurred while the rest of the picture remains brilliantly sharp." When this effect occurs no effort of will suffices to overcome it, but our correspondent finds that normal vision is restored on going into another room lighted by tungsten lamps. Although he has experienced this central blurring and extra-macular sharpening of vision under fluorescent lighting on more than one occasion, he has not yet succeeded in producing this effect at will for investigation. It is, he says, "a maddening effect," and while he thinks fatigue favours its occurrence, he suspects it is due to the spectral distribution of energy in the radiation from fluorescent lamps. It would be interesting to know whether any other reader has had a similar experience. We have tried to produce it ourselves but, like our correspondent, have found it unbiddable.

The importance of maintenance in the case of indirect lighting is well brought out in a paper we have seen in a recent issue of the American journal "Occupational Medicine." The authors measured the average illumination at desk level in each of four offices in which indirect lighting had been installed for a considerable period, and then they had the ceilings repainted, the lighting fittings cleaned and, finally, the lamps renewed. After each stage in this maintenance programme they re-determined the average illumination. Painting the ceilings brought about the greatest percentage increase of illumination and re-lamping the least. As the result of all the measures adopted, the illumination on the working plane was increased threefold in each of the rooms.

1949

and
han
nce
the
ntly
fort
our
n is
om
he
ing
ion
an
led
es-
ing
gue
is
of
ent
ow
a
to
re-

he
ht
nt
u-
rs
at
ch
or
ey
g
os
is
r-
t-
e
i-
e
e
s
s.